Claims

1. A method to provide a subject with different glycoprotein hormone activities which method comprises administering to a subject in need of said activities a composition of the formula:

β^1-(linker^1)$_m$-α-(linker^2)$_n$-β^2 (1);

β^1-(linker^1)$_m$-β^2-(linker^2)$_n$-α (2);

α-(linker^1)$_m$- β^1-(linker^2)$_n$-β^2 (3);

$\beta^2 \approx \alpha$-(linker)$_m$-β^1 (4); or

β^1-(linker)$_m$-$\alpha \approx \beta^2$ (5)

wherein each of β^1 and β^2 has the amino acid sequence of the β subunit of a vertebrate glycoprotein hormone, or a variant thereof;

"α" has the amino acid sequence of the α subunit of a vertebrate glycoprotein hormone or a variant thereof;

"linker" is a linker moiety; and

"$\approx$" is a noncovalent link between α and β^2;

each of m and n is independently 0 or 1;

wherein each of β^1 and β^2 confer a different activity on said composition.

2. The method of claim 1 wherein β^1 and β^2 correspond to different native β subunits.

3. The method of claim 1 wherein β^1 and β^2 exhibit different biological half-lives.

4. The method of claim 1 wherein one of β^1 and β^2 confers agonist activity and the other confers antagonist activities.

5. The method of claim 1 wherein said subject is in need of enhanced fertility.

6. The method of claim 5 wherein both β^1 and β^2 confer FSH agonist activity on said composition; or

wherein both β^1 and β^2 confer CG agonist activity; or

wherein both β^1 and β^2 confer LH antagonist activity; or

wherein one of β^1 and β^2 confers FSH agonist activity and the other confers LH antagonist activity or lowered LH agonist activity; or

wherein one of β^1 and β^2 confers FSH agonist activity and the other confers CG agonist activity; or

wherein one of β^1 and β^2 confers LH antagonist activity or lowered LH agonist activity and the other confers CG agonist activity.

7. The method of claim 1 wherein said subject is in need of becoming or remaining infertile.

8. The method of claim 7 wherein both β^1 and β^2 confer FSH antagonist activity on said composition; or

wherein both β^1 and β^2 confer CG antagonist activity; or

wherein both β^1 and β^2 confer LH agonist activity; or

wherein one of β^1 and β^2 confers FSH antagonist activity or lowered FSH agonist activity and the other confers LH agonist activity; or

wherein one of β^1 and β^2 confers FSH antagonist activity or lowered FSH agonist activity and the other confers CG antagonist activity or lowered CG agonist activity; or

wherein one of β^1 and β^2 confers LH agonist activity and the other confers CG antagonist activity or lowered CG agonist activity.

9. The method of claim 1 wherein the subject is in need of treatment for polycystic ovarian disease.

10. The method of claim 9 wherein one of β^1 and β^2 confers FSH agonist activity and the other confers LH antagonist activity or lowered LH agonist activity on said composition; or

wherein both β^1 and β^2 confer FSH agonist activity; or

wherein both β^1 and β^2 confer LH antagonist activity.

11. A glycosylated or nonglycosylated composition of the formula

$\beta^2 \approx \alpha\text{-(linker)}_m\text{-}\beta^1$ (4); or

$\beta^1\text{-(linker)}_m\text{-}\alpha \approx \beta^2$ (5)

wherein each of β^1 and β^2 has the amino acid sequence of the β subunit of a vertebrate glycoprotein hormone, or a variant thereof;

"α" has the amino acid sequence of the α subunit of a vertebrate glycoprotein hormone or a variant thereof;

"linker" is a linker moiety; and

"≈" is a noncovalent link between α and β^2;

m is 0 or 1;

wherein each of β^1 and β^2 confer a different activity on said composition; and

with the proviso that if β^1 is CG then β^2 is not FSH.

12. A pharmaceutical composition which regulates the glycoprotein hormone concentrations in a mammal which comprises an effective amount of the composition of the formula

$\beta^2 \approx \alpha\text{-(linker)}_m\text{-}\beta^1$ (4); or

$\beta^1\text{-(linker)}_m\text{-}\alpha \approx \beta^2$ (5)

in admixture with at least one pharmaceutically acceptable excipient; and

wherein each of β^1 and β^2 has the amino acid sequence of the β subunit of a vertebrate glycoprotein hormone, or a variant thereof;

"α" has the amino acid sequence of the α subunit of a vertebrate glycoprotein hormone or a variant thereof;

"linker" is a linker moiety; and

"≈" is a noncovalent link between α and β^2;

each of m and n is independently 0 or 1;

wherein each of β^1 and β^2 confer a different activity on said composition; and

with the proviso that if β^1 is CG then β^2 is not FSH.

13. Recombinant host cells modified to contain a nucleic acid comprising a first expression system comprising a nucleotide sequence encoding α-$(linker)_m$-β^1 or β^1-$(linker)_m$-α operably linked to a control sequence for the expression thereof and a nucleic acid comprising a second expression system comprising a nucleotide sequence encoding for β^2 operably linked to a control sequence for the expression thereof;

wherein α, β^1, β^2, linker and m are as defined in claim 11.

14. The cells of claim 13 wherein the first expression system and second expression system share the same control sequence.

15. The cells of claim 13 wherein the first expression system and the second expression system reside on separate extrachromosomally replicating vectors.

16. The cells of claim 13 wherein the first expression system and second expression system reside in a chromosome of the host cell.

17. The cells of claim 13 wherein one of said first and second expression systems resides in the chromosome of said cells and the other is on an extrachromosomally replicating vector.

18. The cells of claim 13 wherein both first and second expression systems reside on the same extrachromosomally replicating vector.

19. A method to produce composition of formula (4) or (5) which method comprises

culturing the cells of claim 13 under conditions wherein said composition is produced; and

recovering said compositions from the culture.

20. Antibodies specifically immunoreactive with the composition of claim 11.